Protection of a surface by partially subjecting it to an electrochemical treatment

The invention relates to a method as described in the introductory part of claim 1, and to an object as described in the introductory part of claim 8.

Such a method, and such an object, are disclosed in United States patent specification 3 284 321. In accordance with said patent specification, a surface is partially provided with a mask and subsequently electrochemically treated by anodizing it. Only the first, non-masked area of the surface is provided with an anodized layer. As described in said patent specification, the anodized area of the surface is subsequently sealed, so that it is no longer porous. Next, the mask is removed, for example by means of a solvent, and the surface is re-anodized. As the surface area anodized during the first anodizing treatment is sealed, the second anodizing treatment has little or no effect on the surface area anodized during the first anodizing treatment.

In this manner, a surface is obtained comprising two or more optically different areas, which surface is wear and scratch-resistant, and protected against chemical attack, said surface additionally being visually attractive. Also the anodized layer formed during the second anodizing treatment is preferably sealed.

As a result of said properties, electrochemically treated surfaces, such as anodized and chrome-plated surfaces can very suitably be used as the outer layer of parts of utensils which are subjected to intensive contact with users, such as housing parts of, in particular shaver heads, of shavers (in this respect, also the resistance to solvents and compositions for personal care such as shaving lotions, shaving soap and the like is important), control buttons, gear lever knobs, handles, clasps of bags and suitcases, and stationery.

However, the removal of the mask and the re-anodizing treatment are laborious. In addition, the use of solvents to remove masks requires special measures to preclude emissions of volatile solvents into the environment and to preclude excessive exposure of employees to such volatile solvents.

It is disclosed in United States patent specification 3 450 606 to partially anodize and color surfaces by first anodizing the whole surface and, if necessary, coloring it, after which parts of the anodized and, possibly, colored surface are partially masked, whereafter the anodized layer is etched from the non-masked parts and, subsequently, the surface is again immersed in an anodizing bath, whereby the etched parts are anodized in a second color. Also these anodized surfaces can be masked, partially etched and anodized in a different color. Repeatedly anodizing, masking, etching and re-anodizing is laborious and hence expensive.

United States patent specification 3 284 321 and German patent application 23 63 667 both describe the application of a resist onto the areas of a surface that are not to be anodized, after which the surface is anodized and, next, the resist is removed by immersing in a bath. Also in this case, the removal of the resist after the anodizing treatment is laborious. In addition, the initially masked surface region is not provided with a protective layer.

Japanese patent application 62-278277 describes a similar method of partially anodizing a surface, wherein, in addition, the surface is provided with a transparent protective film which covers the anodized and the non-anodized parts of the surface. The application of such a resist requires an additional operation and generally results in a not entirely satisfactory resistance to attack when an object coated with such a resist is intensively used.

It is an object of the invention to obtain, in a simpler manner, a wear and scratch-resistant protective layer which comprises at least two visually distinguishable types of surface areas.

In accordance with the invention, this object is achieved by using a method as claimed in claim 1. Such a method can be advantageously used to obtain an object as claimed in claim 8.

In this manner, as a result of masking, also the second surface area of the intended, highly wear and scratch-resistant protective layer is obtained. Consequently, to obtain the protection in the second surface area, an additional stripping treatment and/or electrochemical treatment is no longer necessary.

In addition, the sol-gel layer is substantially intact after electrochemical treatments, such as anodizing and, possibly, sealing, and also along the edges there is no

substantial attack due to creep under the sol-gel layer. As a result, the support can be provided with a clear-cut, visually attractive pattern.

In the course of the electrochemical treatment, the sol-gel layer serves as an isolator, so that said electrochemical treatment is not effective in the masked area. This applies to treatments in which material is converted, such as an anodizing treatment, as well as to electroplating treatments in which material is deposited, such as zinc-plating, nickel-plating, chrome-plating and tin-plating.

Particularly advantage embodiments of the invention are described in the dependent claims.

Further objects, aspects, effects, advantages and details of the invention become apparent from the following description of a few possible embodiments of the invention, wherein reference is made to the drawing.

The drawing is a flow chart of successive treatments and intermediate stages of an example of a method in accordance with the invention, comprising illustrations which depict a part of the housing of a shaver head of a shaver having rotary cutters in different stages of the treatment process.

The method shown in the drawing is a currently most preferred method of carrying out the invention to obtain an object with a surface having three distinguishable types of surface areas 1, 2, 3 and an uncoated engraved area 4. The areas 2 and 3 each consist of two portions, which are not interconnected, and which are indicated by means of the same reference numerals for the sake of simplicity.

First of all, a ball milling treatment 5 polished is carried out resulting in a polished state 6 which is illustrated in this example by a polished housing part 7 of the shaver.

Subsequently, the polished surface is lacquered (step 8) using a sol-gel, after which a matt state 8 is obtained in this example which is illustrated by the housing part 10 of the shaver head. It is alternatively possible to apply a glossy sol-gel lacquer.

For more information about sol-gel layers and the application thereof, reference is made to international patent applications WO 98/22548 and WO 98/13434, the contents of which is included herein by reference, and which both relate to layers of the sol-

gel type. The sol-gel layer may be formed, for example, from a polymeric material, for example on the basis of polysilicate, which is provided by means of a sol-gel process. The main chain or "backbone" of the sol-gel polymer comprises inorganic compounds; any side groups or side branches may be organic, if necessary.

The sol-gel layer can be obtained by applying a sol-gel substance directly onto the support 7 and converting said sol-gel substance to the polymeric material.

The thickness of the sol-gel layer is preferably below 50 μm. In accordance with this example, the housing part 7 of the shaver head is made from an aluminium alloy. To obtain a good distribution and adhesion, it may further be advantageous to use organically modified silanes, such as aminopropyltrimethoxy silane (A1100).

The sol-gel layer of an inorganic polymeric material comprises, dependent upon the desired visual effect, fillers in the form of particles having certain visual properties, such as pigments and glittery particles.

Subsequently, the sol-gel layer is partially removed. In this example, the sol-gel layer is removed from first areas 2 of the surface of the housing part of the shaver head (step 11), after which a state 12 is obtained which is illustrated by the housing part 13 of the shaver head, the first areas 2 of which have bright aluminium surfaces, and the second area 1 is matt.

As, in the method in accordance with this example, the sol-gel layer is initially applied to an area which is larger than the second surface area 1, which eventually must be provided with a sol-gel layer, and, prior to anodizing, areas of the sol-gel layer are removed, the application of the sol-gel layer can be carried out very rapidly and without the risk of spattering and spilling. The removal of parts of the cured sol-gel layer is comparatively easy to control and can be carried out more accurately than the application of a sol-gel layer in accordance with a specific pattern using a wet process.

The removal of areas of the cured sol-gel layer is carried out, in this example, by processing using a laser beam. This has the advantage that it permits great freedom of design as regards the shape of the areas, that a high degree of accuracy can be attained, that the surface of the aluminium support is hardly subject to attack, and that the risk of damage is small.

Subsequently, the housing part of the shaver head is subjected to an electrochemical treatment which, in accordance with this example, consists of an anodizing treatment 14, which is preferably rounded off with a sealing treatment, in which anodizing treatment only the bright aluminium surface in the first areas 2 is anodized and a state 15 is

obtained wherein a surface area 1 of the housing part 16 of the shaver head is matt and the previously bright aluminium surface areas 2 are anodized. The rest of the surface area 1 of the housing part of the shaver head is masked by the sol-gel layer and, consequently, remains untreated. In this example, the first areas 2 are anodized so as to be bright. The two types of surface areas 1, 2 may differ from each other as regards brightness as well as shade and color. The proposed method is now complete if two types of visually different surface areas are sufficient.

The thus obtained housing part 16 of the shaver head has an at least partly aluminum support with a surface provided with a protective layer having surface areas 2 of a first type whose protective layer is formed by an annealed outer layer, in this case a bright annealed outer layer, and a surface area 1 of a second type whose protective layer is a sol-gel layer. Dependent upon the way in which the sol-gel layer and the anodized layer are made, the surface areas 1, 2 may be distinguishable in that they differ from each other in one or more visual aspects, such as brightness, color and shade.

Just like an anodized layer and many other electrochemically treated surfaces, a sol-gel layer has a high resistance to wear and scratches and is resistant to many solvents, so that it can very suitably be used as a visually distinguishable protective layer in a surface area adjoining an anodized layer or another electrochemically formed layer. Therefore, the mask formed by a sol-gel layer can also be used as the ultimate protective layer in the masked area.

According to the method described by way of example, two types of different surface areas do not suffice, so that the housing part of the shaver head is provided with four types of different surface areas 1-4.

For this purpose, after the first anodizing operation 14, further areas 3 of the anodized layer in the first surface area 2 and of the sol-gel layer in the second surface area 1 are removed (step 17), also in this case by engraving using a laser beam, whereafter, in accordance with this example, a state 18 is obtained. The housing part 19 of the shaver head shown to illustrate this state is provided with laser-engraved, third, bright aluminium surface areas 3 which extend in both the area of the anodized layer and the area of the sol-gel layer. As the laser can remove parts of the anodized layer as well as parts of the sol-gel layer, one treatment for locally removing the sol-gel layer and the anodized layer is sufficient.

Also these third, bright aluminium surface areas 3 are subsequently protected and colored by subjecting the housing part of the shaver head to a second anodizing, coloring and sealing treatment 20. In this treatment, only the further areas 3 of the surface from which

sol-gel material is removed by the anodizing treatment 20 undergo a substantial change of at least one visual property. Consequently, the third areas can be distinguished from the other two types of surface areas 1, 2 on the basis of, for example, color, shade and/or brightness. The treated housing part of the shaver head has then reached a state 21 wherein it exhibits colored indications, as illustrated by the housing part 22 of the shaver head.

As the first surface areas 2 are sealed after the first anodizing treatment 14, the second anodizing treatment 20 has very little influence on the visual properties of the surface areas 2 anodized during the first anodizing treatment 14.

Finally, a further laser-engraving operation 23 is carried out to bring the housing part of the shaver head in the state illustrated by the housing part 25 of the shaver head, in which state this housing part is provided with a text in the sol-gel layer.

From the foregoing, it will be clear to those skilled in the art that, within the scope of the invention, many alternative embodiments are possible, such as providing the sol-gel layer directly in accordance with a certain pattern, or applying the sol-gel layer in accordance with a rough pattern, after which only a limited quantity of the sol-gel material has to be removed to obtain a marking of the desired shape. Sol-gel material may also be removed in a different way, for example in combination with a material-removing operation to which parts of an object are subjected, such as turning a surface clean or milling it. It is also possible to employ a different electrochemical treatment, such as chrome-plating, tin-plating and the like.

Glossary of reference signs:

5	ball milling
6	gloss
8	sol-gel lacquering
9	sol-gel
11	partially remoral sol-gel
12	soll-gel + uncoated aluminium
14	anodize, seal
15	sol-gel + anodized layer
17	laserengraving
18	Solgel + anodized layer + uncoated aluminium
20	anodize, color, seal
21	Sol-gel + anodized layer +/- + anodized layer II

23	laser engraving
24	Sol-gel + anodized layer I + anodized layer II + engraving